Statistics Content of Elementary School Mathematics Textbooks

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Introduction

Each day, increasing amounts of data and information are made available through various sources. Individuals are challenged with the task of filtering, critiquing, analyzing, and interpreting this information to make decisions. Because of this, the ability to adeptly utilize and understand statistics is a critical skill for consumers and will continue to be in the future. In the 1950s, statistics was recommended as a stand-alone course for mathematically-able high school students. The emphasis on statistics has continued to grow and statistical standards now appear in the elementary grades.

We situate our work within the Center for the Study of Mathematics Curriculum (n.d.) framework, which describes the relationships between standards, textbooks, teachers' instruction, and the mathematics that students learn. The content of textbooks is influenced by factors such as perceptions of the market, recommendations from professional organizations, and state and national standards. In turn, mathematics textbooks influence what is taught and ultimately learned. Specifically, our research seeks to answer the question, "What is the nature and extent of the statistical content in U.S. textbooks for students in grades 1-5?"

Unit of Analysis

We selected five textbook series grades 1-5 and determined statistics tasks by their context and the presence of variability.

27. **Extend Your Thinking** A lionfish has 13 spines on its back, 2 near the middle of its underside, and 3 on its underside near its tail. Using a property of addition, write two different number sentences to find how many spines a lionfish has. What property did you use?

1. Use the table to complete the pictograph.

DATA

Favorite School Lunch		
Lunch	Tally	Number
Taco	//	2
Pizza	𝍸 ///	8
Salad	///	3

Favorite School Lunch
Taco
Pizza
Salad

Each = 2 votes.
Each = 1 vote.

Task #1 is an example of a statistics task (A1, A3) and task #27 is not statistics.

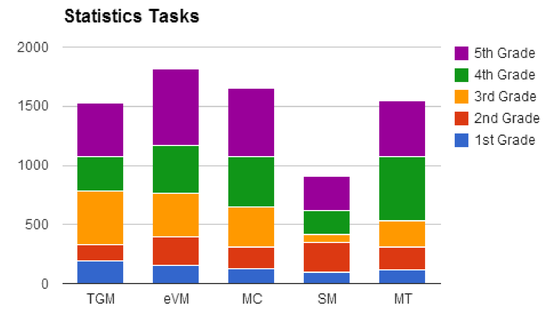
Coding Protocol

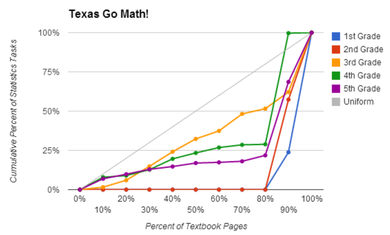
Each task was coded using the four phases of the statistical process adapted from the *GAISE Report*. Tasks can be coded as more than one phase.

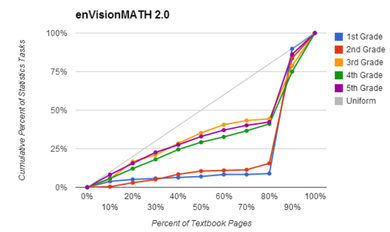
- F = Formulate a Question
- C = Collect Data
- A = Analyze Data
  - A1 = Read a Display
  - A2 = Perform a Mathematical Calculation
  - A3 = Construct a Display
  - A4 = Use Statistical Reasoning Beyond Reading a Display or Doing Mathematical Calculations
- I = Interpret Data

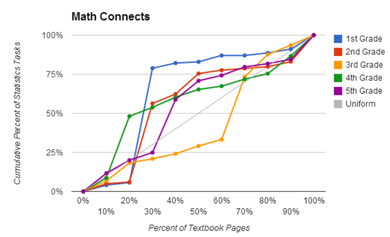
Results

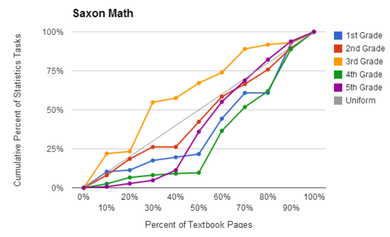
	Texas Go Math!	enVisionMATH 2.0	Math Connects	Saxon Math	Math Trailblazers	TOTALS
Stats Tasks	1524	1821	1648	907	1545	7445
Stats Pages	480	767	587	404	408	2646
Book Pages	3522	4716	3445	3749	2256	17688
Tasks per Stats Page	3.175	2.374	2.807	2.245	3.787	2.814
Tasks per Book Page	0.433	0.386	0.478	0.242	0.685	0.421
Percentage of Book Pages with Stats	13.63%	16.26%	17.04%	10.78%	18.09%	14.96%

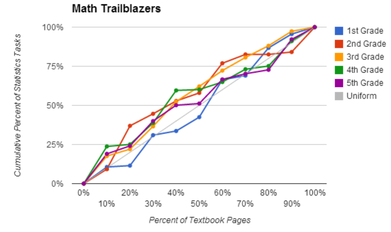




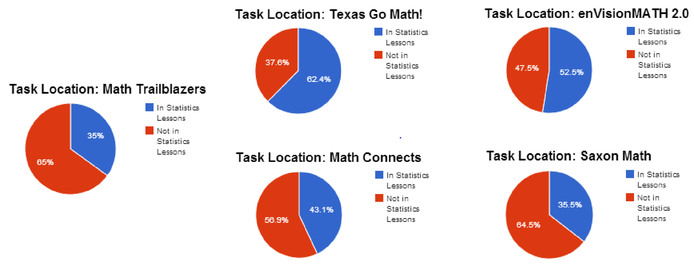






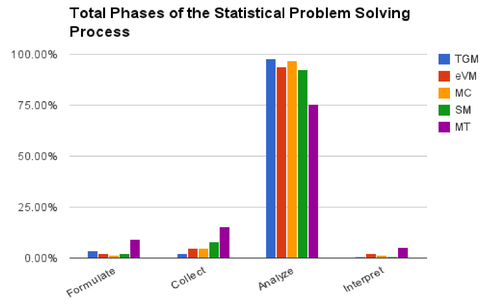


Location of Statistics Tasks

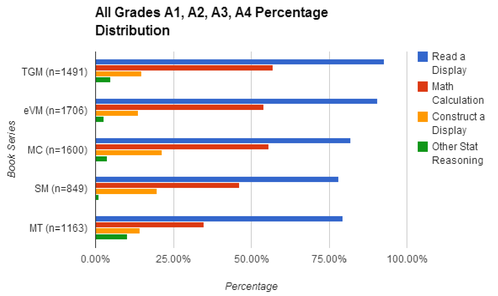


Phase Distribution

	Texas Go Math!		enVisionMATH 2.0		Math Connects		Saxon Math		Math Trailblazers	
Formulate	52	3.4%	41	2.3%	19	1.2%	19	2.1%	19	9.2%
Collect	31	2.0%	90	4.9%	78	4.7%	73	8.0%	73	15.3%
Analyze	1491	97.8%	1706	93.7%	1600	97.1%	849	92.5%	849	75.3%
Interpret	9	0.6%	40	2.2%	20	1.2%	6	0.7%	6	5.3%



CCSS	1.MD.C.4	2.MD.D.10	3.MD.B.3	4.MD.B.4	5.MD.B.2
TGM	M	M	M	M	M
eVM	M	M	M	P	M
MC	M	M	M	P	P
SM	M	M	M	P	P
MT	M	P	P	N	N



TEKS	1.8A	1.8B	1.8C	2.10A	2.10B	2.10C	2.10D
TGM	M	M	M	M	M	M	M
eVM	M	M	M	M	M	M	M
MC	M	M	P	M	M	M	M
SM	P	M	P	M	M	P	P
MT	M	P	P	M	P	P[1]	M
TEKS	3.8A	3.8B	4.9A	4.9B	5.9A	5.9B	5.9C
TGM	M	M	M	M	M	M	M
eVM	M	M	M	M	M	M	M
MC	M	M	P	M	P	M	M
SM	M	M	M	P	P	M	M
MT	M	M[2]	N	M	P	M	M

Implications

Our results suggest that elementary mathematics textbooks do not place equal emphasis on the different phases of the statistical process. Textbooks predominantly focus on analyzing data, which reflects the findings of Newton et al. (2011) regarding GLEs. This may inadvertently restrict opportunities for students to generate and interpret data. Within the analyze phase, there may be too much of an emphasis on procedural tasks. As technology advances and the need for computation diminishes, the demand for problem-solvers will overwhelmingly increase (Wild & Pfannkuch, 1999). Students need more exposure to tasks involving statistical reasoning beyond reading and constructing displays and performing mathematical calculations.

Textbook authors should incorporate more phases of the statistical process throughout the entire textbook. Allowing students to design and conduct surveys would increase exposure to Formulate and Collect tasks. Authors should also include more tasks that require students to interpret results. Teachers should be prepared to supplement textbooks with real-world statistics tasks, which could be integrated with other mathematics topics or other subject areas. These efforts encourage the development of a statistically literate society.

References

Altieri, M. B., Balka, D. S., Day, R. D., Gonsalves, P. D., Grace, E. C., Krulik, S., et al. (2009). *Math connects*. Columbus, OH: McGraw-Hill.

Center for the Study of Mathematics Curriculum (n.d.). *Curriculum research framework*. Retrieved from http://www.mathcurriculumcenter.org/research_framework.php

Charles R., Caldwell J., Copley J., Crown W., Fennell F., Murphy S., … Schielack J (2015). *enVisionMATH Texas 2.0* Upper Saddle River, NJ: Pearson Education Inc.

Dixon, J. K., Burger, E. B., Larson, M. R., & Sandoval-Martinez, M. E. (2015). *Texas go math!* Chicago, IL: Houghton Mifflin Harcourt.

Franklin, C., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M., & Scheaffer, R. (2007). *Guidelines for assessment and instruction in statistics education (GAISE) report: A pre-K–12 curriculum framework*. Alexandria, VA: American Statistical Association.

Hake, S., & Larson, N. (2008). *Saxon math*. Orlando, FL: Harcourt Achieve Inc.

Newton, J., Horvath, A. K., & Dietiker, L. (2011). The statistical process: A view across the K-8 state standards. In J. P. Smith, III (ed.), *Variability is the rule: A companion analysis of the K-8 state mathematics standards* (pp. 119-159). Charlotte, NC: Information Age Publishing, Inc.

Wagreich, P., Bieler, J. L., Goldberg, H., Kelso, C. R., Beissinger, J. S., Cirulis, A., et al. (2008). *Math trailblazers.* Dubuque, IA: Kendall/Hunt Publishing.

Wild, C. J. & Pfannkuch, M. (1999). Statistical thinking in empirical enquiry. *International Statistical Review, 67*(3), 223-265.